AD				

GRANT NUMBER DAMD17-96-1-6268

TITLE: Predictors of Back Injury Among Women Military Recruits

PRINCIPAL INVESTIGATOR: Dr. Michael Weaver

CONTRACTING ORGANIZATION: The University of Alabama

Birmingham, Alabama 35294-0111

REPORT DATE: November 1998

TYPE OF REPORT: Annual

PREPARED FOR: Commander

U.S. Army Medical Research and Materiel Command Fort Detrick, Frederick, Maryland 21702-5012

DISTRIBUTION STATEMENT: Approved for public release;

distribution unlimited

The views, opinions and/or findings contained in this report are those of the author(s) and should not be construed as an official Department of the Army position, policy or decision unless so designated by other documentation.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperyork Reduction Project (0704-0188). Washington DC 2056

1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE	3. REPORT TYPE AM	ID DATES COVERED
The state of the s	October 1998		Oct 97 - 30 Sep 98)
4. TITLE AND SUBTITLE	<u> </u>		5. FUNDING NUMBERS
Predictors of Back Injur	v Among Women Mili	tary Recruits	DAMD17-96-1-6268
reduced of Back injur	y ranorig nomen nizza	cary Recruits	
A AUTHORIO			4
6. AUTHOR(S)			
Dr. Michael Weaver			İ
. PERFORMING ORGANIZATION NAM	E(S) AND ADDRESS(ES)		8. PERFORMING ORGANIZATION
			REPORT NUMBER
University of Alabama			
Birmingham, AL 35294-01	11		
	. 1	Y 4	
. SPONSORING/MONITORING AGENC	Y NAME(S) AND ADDRESS(ES)	10. SPONSORING/MONITORING
Commander	•		AGENCY REPORT NUMBER
U.S. Army Medical Resear	· · · · · · · · · · · · · · · · · · ·		
Fort Detrick, Frederick,	Maryland 21702-5	012	1
	•		
1. SUPPLEMENTARY NOTES		100	90407 084
		177	70401 004
2a. DISTRIBUTION / AVAILABILITY ST	TATEMENT		12b. DISTRIBUTION CODE
	11 / 12 / 1		
Approved for public release	ase; distribution	unlimited	
			·
3. ABSTRACT (Maximum 200			
·			
Military recruit training is physically	demanding and results in a	high rate of musculoskel	etal injuries. Identification of back
injury risk factors and the successful	development of preventive	measures could significat	ntly decrease recruiting expenses, los
time due to injury, and training costs	for female military recruits.	•	
The aims of this prospective, non-ex		•••	
I ha aims at this means active man are	nommantal abidu of famala -		

1. Recommend exercise and educational interventions for reducing the incidence of back injury.

2. Identify risk factors for back injury and discomfort by testing (a) aerobic capacity, (b) upper body strength, (c) lower body strength, (d) functional lifting ability, (e) hamstring flexibility, (f) percent body fat, (g) smoking, (h) previous back injury, (i) back knowledge, (j) life satisfaction, (k) anxiety, (l) demographic factors.

3. Describe the distribution of types of back injuries which occur in women recruits and the basic training tasks which are leading causes of back injury in this group of recruits.

A convenience sampy of 1200 female recruits attending basic training at Naval Recruit Training Command, Great Lakes will be examined. Back injury and back discomfort, the response variables, will be obtained from medical records and a self-report questionnaire prior to graduation.

14. SUBJECT TERMS Defense Back Injury Functional Lift Ab		•	15. NUMBER OF PAGES 46 16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT	18. SECURITY CLASSIFICATION OF THIS PAGE	19. SECURITY CLASSIFICATION OF ABSTRACT	20. LIMITATION OF ABSTRACT
Unclassified	Unclassified	Unclassified	Unlimited

FOREWORD

Opinions, interpretations, conclusions and recommendations are those of the author and are not necessarily endorsed by the U.S. Army.

Where copyrighted material is quoted, permission has been obtained to use such material.

Mhere material from documents designated for limited distribution is quoted, permission has been obtained to use the material.

Citations of commercial organizations and trade names in this report do not constitute an official Department of Army endorsement or approval of the products or services of these organizations.

In conducting research using animals, the investigator(s) adhered to the "Guide for the Care and Use of Laboratory Animals," prepared by the Committee on Care and use of Laboratory Animals of the Institute of Laboratory Resources, national Research Council (NIH Publication No. 86-23, Revised 1985).

For the protection of human subjects, the investigator(s) adhered to policies of applicable Federal Law 45 CFR 46.

In conducting research utilizing recombinant DNA technology, the investigator(s) adhered to current guidelines promulgated by the National Institutes of Health.

In the conduct of research utilizing recombinant DNA, the investigator(s) adhered to the NIH Guidelines for Research Involving Recombinant DNA Molecules.

In the conduct of research involving hazardous organisms, the investigator(s) adhered to the CDC-NIH Guide for Biosafety in Microbiological and Biomedical Laboratories.

Milael S. Weave 29 October 1994

PI - Signature

Date

Table of contents

FRONT COVER	1
STANDARD FORM SF298	2
FOREWORD	3
TABLE OF CONTENTS	4
INTRODUCTION	5
RESEARCH QUESTIONS	
HYPOTHESES	5
TECHNICAL OBJECTIVES	6
BACKGROUND	6
Physical Performance and Injury	
Behavioral and Psychosocial Correlates of Back Injury	9
Low Back Injury in Military Recruits	
BODY	
METHODS	
Design, Sample, and Research Setting	11
RESPONSE VARIABLES	12
PREDICTOR VARIABLES	13
DATA COLLECTION PROCEDURES	14
RESULTS: NO RESULTS ARE AVAILABLE AT THIS TIME	13
RECOMMENDATIONS	15
SITE ACQUISITION	15
PROTOCOL REVISION	15
Subject Testing	
Data Collection	16
SUMMARY	
CONCLUSIONS: NO CONCLUSIONS ARE AVAILABLE AT THIS TIME	
REFERENCES	
APPENDICES	
APPENDIX A	22
Data Collection Instruments	22
Forms Completed by Subjects At Entry	23
Forms Completed by Subjects At Exit	31
Forms Completed by Project Staff At Entry	33
Forms Completed by Project Staff At Exit	
APPENDIX B.	39
Permission To Conduct Research at RTC, Great Lakes	39
APPENDIX C	
One Year No-Cost Extension	
APPENDIX D	
Revised Statement Of Work	

Introduction

The overall goal of this study is to gain a better understanding of development of back injury in female military recruits during basic training. Just as any vigorous exercise or sports program may increase injury rates, basic training for new recruits results in a high risk for musculoskeletal injuries. Musculoskeletal injuries among recruits contributes to lost time, pain, medical costs, and even attrition. Although women recruits have been found to be at higher risk than men for some training-related injuries ^{1,2}, no studies have been reported on the risks of women recruits for back injury. Therefore, an expected result of the study will be the identification of predictors of back injury which will be beneficial to the armed forces in preventing back injuries and lowering costs among women recruits. Five specific aims will be addressed toward achieving the study's overall goal:

- 1. To describe the incidence and prevalence of back injury in women military recruits participating in basic training.
- 2. To describe the distribution of types of back injuries in women military recruits participating in basic training.
- 3. To identify basic training tasks which are leading causes of back injury.
- 4. To identify physical fitness, functional lifting ability, behavioral, back knowledge, psychosocial, and demographic factors which correlate with development of back injury in women military recruits participating in basic training.
- 5. To identify a model which can predict the likelihood of back injury in women military recruits participating in basic training.

These aims are addressed within the following research questions (aims 1, 2, 3, and 5) and hypotheses (aim 4):

Research Questions

- 1. What is the incidence of back injury in women military recruits participating in basic training?
- 2. What is the prevalence of back injury in women military recruits participating in basic training?
- 3. What is the distribution of types of back injuries in women military recruits participating in basic training?
- 4. What basic training tasks are most frequently associated with back injury?
- 5. Which of the selected physical fitness, functional lifting ability, back knowledge, behavioral, psychosocial, and demographic variables are required in a logistic regression model to predict development of back injury in women military recruits participating in basic training?

Hypotheses

1. There will be significant associations between development of back injury in women military recruits participating in basic training and: (a) aerobic capacity (two mile run time), (b) upper

body strength (number of push-ups and sit-ups in a two minute period), (c) lower body strength (number of squats in a one minute period), (d) functional lifting ability (floor-to-waist lift task), (e) hamstring flexibility (sit-and-reach), (f) body composition (body mass index; percent body fat), (g) smoking, (h) previous back injury, (i) back knowledge, (j) life satisfaction, (k) anxiety (Spielberger State-Trait Anxiety Questionnaire), (l) age, and (m) race.

Technical Objectives

Four technical objectives will be addressed within this study:

- 1. Measure and describe back injuries in a cohort of female military recruits undergoing basic training. This objective involves describing incidence and prevalence of back injuries and the distribution of type of back injury.
- 2. Describe the types of basic training activities associated with back injury.
- 3. Identify risk factors for back injury by testing for significant associations between development of back injury in women military recruits participating in basic training and: (a) aerobic capacity, (b) upper body strength, (c) lower body strength, (d) functional lifting ability, (e) hamstring flexibility, (f) body composition, (g) smoking, (h) previous back injury, (i) back knowledge, (j) life satisfaction, (k) anxiety, (l) age, and (m) race.
- 4. Develop a model to predict likelihood of developing back injury in female military recruits during basic training.

The identification of risk factors and a predictive model for back injury are the first steps required in order to develop screening and training interventions to prevent back injury. Development of successful preventive strategies could significantly decrease recruiting expenses, turn-over rates, lost time due to injury, and training costs for female military recruits.

Background

This study is guided by an injury control perspective. Within this perspective, health problems, such as back injury, are viewed as preventable if interventions are adopted which protect the individual from stressors that threaten to disrupt system stability. Requirements of basic training are considered occupational stressors which may result in back injury. The objective of this study is to identify factors which are associated with development of back injury. Once those factors are identified, preventive screening and training interventions designed to reduce risk of back injury could be incorporated into the basic training routine.

Military recruit training is physically demanding and results in excessive musculoskeletal injuries ³. Vigorous exercise requirements during basic training pose risks for musculoskeletal injury among recruits, many of whom are not physically fit upon entry into military service. Despite publicity given to the hazards of deployment, recruit training and routine military work present greater continuing hazards because of the mandatory fitness testing, marching, field exercises, and frequent lifting of heavy materials ⁴. Musculoskeletal injuries among recruits result in pain, lost training time, medical costs, and inability to complete training ⁵. The Army reported that 9 percent of the discharges within the first six months of service were attributed to low back

problems ⁶. From 1990 to 1991, two-thirds (67%) of the medical discharges in the Air Force were for new recruits in basic training and resulted in cost of \$2.7 million ⁷. Women recruit trainees have been found to have more lost time injuries than males in the same recruit training regimens ^{1,2}. Prevention clearly is indicated to reduce musculoskeletal injuries among women recruits.

Statistics about occupational musculoskeletal injuries and back injuries are alarming. Low back injury is the leading cause of compensable injury and only the common cold results in more absenteeism in the workplace ⁸. Expenditures for medical care, workers' compensation and lost work time resulting from back injury are estimated at 56 billion dollars per year ⁹. Because industry is experiencing increased rates of back disabilities and is seeking ways to control these costs, the American Association of Occupational Health Nurses has identified back injury prevention research as one of its twelve priority areas ¹⁰. Simultaneously the Department of Health and Human Services in Healthy People Year 2000 ¹¹ proposes a national health objective to increase to at least 50 percent the number of worksites which offer back injury prevention programs.

Uncertainty about the causes and pathophysiology of back injury continue to complicate efforts to control occupational back problems ¹². Hypotheses about the causes of low back injury include: (a) muscle incoordination during rapid motion, (b) muscle fatigue with repetitive movements, and (c) disc degeneration from compression forces during repeated lifting ^{13,14}. Risk factors which have been associated with back injury include weak lumbar and abdominal muscles, obesity, poor posture, physical stressors of heavy or frequent lifting, excessive bending, twisting or reaching, prolonged sitting or standing, vibration, smoking, age, time of day, and anxiety ^{15,16,17,18,19,20,21}.

Attempts to control occupational back injury have traditionally focused on pre-employment x-rays, safety training, and strength testing ²². While employers have held to the notion that x-rays may detect applicants with pre-existing back problems, empirical evidence does not support the use of x-rays for predicting the incidence of back injuries ^{23,24}. In addition, pathology detected from imaging has not been found to correlate with reports of back symptoms ²⁵. More recently, ergonomic task redesign to improve manual materials handling, minimize excessive loads, and alter work stations have demonstrated some success in control of back problems ²⁶. Preplacement medical screening of subjects for minimum job strength requirements has been found to be superior to a traditional medical examination in reducing the incidence of musculoskeletal problems ^{27,28}. No published empirical evidence is available on the use of functional lift measures for predicting back injury among military women.

Physical Performance and Injury

Mechanical trauma is the major prevailing notion for the etiology of work-related back injury. Muscles strained by repetitive or sudden motion undergo an inflammatory response producing symptoms of pain and restricted motion. Even slight trauma limits the extent to which muscle fibers will stretch. When joints are not properly exercised and conditioned, connective tissue in tendons, ligaments, muscles, and joint capsules become dense and shortened; any attempt to regain the lost range of motion in the joint is resisted. This accounts for much of the limitation in range of motion of most joints in the body ²⁹. This natural chain of events can perhaps be

accelerated by repeated microtrauma which occurs when recruits are required to participate in new physical requirements and field exercises throughout basic training.

The use of exercise for prevention of injury is based on experience in military and sports medicine. A review of military, medical, physical therapy, and sports medicine literature supports the notion that flexibility and strength training may ultimately reduce injury rates ^{30,31,32,33}. Gracovetsky and Farfan ³⁴ suggest that stronger trunk musculature can stabilize the spine to protect it from injurious forces. Empirical evidence indicates that sports injuries can be avoided with flexibility and strength training ^{35,36}. However, participation in exercise, conditioning, and military training is known to result in injuries ³. Limited data are available on the incidence of back injuries resulting from military basic training.

Lifting ability is a function of muscular strength, coordination, and flexibility. Muscular strength and flexibility maintain the spine in an erect posture and maintain equilibrium when the center of gravity shifts due to an outstretched arm or carrying a load, etc. Flexibility refers to the suppleness of a joint. With limited flexibility muscles are tight and restrict movement of the joint through the full range of motion. Lack of flexibility has been correlated with an increase in muscular injuries ^{37,38}. Flexibility is accomplished with a stretching routine which serves to lengthen muscle fibers, muscle sheathing, ligamentous joint capsule, and tendons and to make them more pliable. More pliable muscles, tendons, and ligaments are less likely to be injured. Because high demand muscular activity results in microscopic muscle tears that cause the muscle to heal shorter, stretching is recommended to overcome the effects of vigorous muscular activity. Investigators attribute the back inflexibility and pain found in runners, tennis players and other athletes to this healing mechanism. Therefore, back exercises including knee to chest, trunk rotation, hamstring stretch, and press-up exercises are routinely included in exercise training to improve trunk flexibility ³⁹.

Strength refers to the ability of a muscle to contract and exert power. Strength is not simply explained by the size of the muscle but is dependent on motor neuron involvement in activating the muscle fiber ⁴⁰. Strength improvement requires 6-12 weeks of repetitive contractions and has been found to be due to enhanced neural activation through increase in electrical stimulation of motor units, i.e. increase in firing frequency or synchronization of firing between motor units ⁴¹. Specificity of muscle groups is an essential concept in muscle training therefore to strengthen the muscles which support the back (the abdominal muscles and lumbar extensors), sit-ups and exercises such as prone isometrics are usually recommended ³⁹.

Muscular demands in military work may be greater than the muscular stress of sports. Trunk mobility is essential for workplace activities such as lifting and bending ⁴². Although studies demonstrated that vigorous exercise can improve trunk performance ^{43,44}, numerous controversies are found in the literature regarding the value of improving mobility vs. strengthening abdominal and lumbar extensor muscles. The merits of static flexibility training, active flexibility training with or without resistance, aerobics training, or extension training are also topics of debate ^{44,45,46,47}. Further research is needed to correlate lifting ability, fitness levels, and subsequent back injury rates.

Because empirical evidence has demonstrated that low back pain patients have weak abdominal and lumbar muscles and tight hip flexor, hamstring, and lower back muscles, a combination of

isometric flexion, extension, and active flexion exercises are currently utilized in exercise training and exercise prescriptions ³⁹. An emphasis on extension is based on observations that 1) prolonged flexion postures often result in low back pain, and 2) trunk extensor performance exceeds trunk flexor performance in subjects without back pain.

Evidence has been accumulating that workers who have insufficient strength and fitness for their jobs are likely to experience injury ^{12,48,49,50}. Men and women recruits who were less physically fit on entry into military service were found to have greater lost time musculoskeletal injuries than new recruits who were physically fit ¹. In a classic prospective study of 1652 firefighters Cady et al. demonstrated that exercise may have a protective effect in the prevention of back injuries ⁴⁸. Increased levels of physical performance (flexibility, strength, and endurance) were associated with decreased incidence of back injury and decreased duration of back injury symptoms. In a more recent report, Cady and associates demonstrated that firefighters with better than average physical fitness as evidenced by increased flexibility or strength or work capacity had fewer back injuries than those firefighters who were less physically fit ⁴⁹.

Although Cady's initial 1979 findings have been held in high regard, recent conflicting evidence has been reported and indicates the need for further research regarding functional lifting ability measures as predictors for back injury ^{16,51}. In Mostardi's study, strength measured by an isokinetic lifting device was not predictive of injury in the one hundred seventy one women followed prospectively. Women in the military may be at high risk for back injury due to insufficient strength for jobs which have been traditionally performed by men. Studies are needed which use state-of-the art physiologic back testing methods on women recruits in order to study the influence of functional lifting ability as a predictor of back injury.

Behavioral and Psychosocial Correlates of Back Injury

Cigarette smoking has been identified in a number of studies as a correlate of low back pain ^{52,53,54,55}. In one recent study the relationship between smoking status and low back pain was investigated among subjects representing 13 occupations ⁵⁶. Smoking was significantly correlated with back pain in those occupations that required physical exertion. Upon further examination, the researchers determined that smoking was more clearly related to pain in the extremities than to neck or back pain.

Only one study of military recruits has been reported which investigated the relationship between low back pain and smoking 6 . Male recruits ($\underline{n} = 160$) from a single basic training group were studied. After excluding subjects with a previous history of back pain, self-report of back pain during basic training resulted in an incidence rate of 17.0% (95% confidence interval: 11.6% - 24.1%). Two trainees were discharged from the military because of low back pain. Smoking status was significantly related to low back pain. Alcohol use, fitness level before enlistment, age, race, educational level, and work satisfaction were not significant. The investigators considered the study to be initial research on an apparently high risk population, that of military recruits. The study was limited in that no women recruits were included. Further research is indicated to ascertain if smoking is a predictor of back injury among women recruits.

Conflicting results on the relationship between obesity and low back pain have been reported. Manninen and colleagues found no correlation between body mass index and low back pain ⁵³.

The one study of military trainees which examined obesity and injury, including low back injury, tendonitis, sprains, strains, and stress fractures, found no relationship between obesity and injury for women but did find this relationship among men ¹. Other investigators report positive findings. A survey of over 34,000 subjects in England reported that obesity was related to back pain at all ages ⁵⁵. In a study of nursing personnel, severity of back injury was found to be related to weight of the nurse ⁵⁷. In summary, the limited number of investigations on this association reveal only a possible relationship between low back pain and obesity at the upper quintile and fail to examine other psychosocial factors which might be confounding ⁵⁸.

Educational level, age, income, marital status, history of previous back injury, and parenthood have also been found to be related to low back pain ^{54,59,60,61}. A study of 1,149 Finnish men, followed prospectively for 3 years, revealed a fourfold risk for back injury among those with a history of low back pain ⁶². Croft and Rigby (1994) found that back pain was reported more often among women in lower income and educational levels ⁵⁹. However, in O'Connor and Marlowe's study (1993), age, race, educational level, and work satisfaction were not significant predictors of low back pain ⁶. Similarly, a population-based study of 4,000 Belgian adults did not find an association between work satisfaction and initial report of low back pain ¹². Additional studies are needed to investigate the relationship between psychosocial and demographic variables and low back pain in women. No studies of military women recruits have described the relationships between these variables and the development of back injury. For these reasons, the investigators propose to investigate multiple correlates of back injury among military women. Thus, results of this study will lead to scientific information about military women's risks for back injury.

Low Back Injury in Military Recruits

Only a few prospective studies on low back injury in military recruits have been conducted. Hellsing investigated lumbar mobility and tightness of hamstring and psoas major muscles in 999 male recruits upon enlistment in compulsory military service in Sweden and followed these recruits over four years ^{63,64}. No correlations were found between tight hamstring or psoas muscles and current back pain or the incidence of low back pain. Decreased lumbar mobility was related to current back pain at the second and third follow-up periods but was not a predictor of back injury. Clinical assessments utilizing a goniometer were the only methods of measuring mobility therefore subjectivity may have influenced the results. In addition, no women recruits were included in this study.

A recent study of male U. S. marine recruits examined the incidence of soft tissue and musculoskeletal injuries during basic training ⁵. Findings revealed a rate of 19.9 injuries per 100 recruit months. The most frequently occurring injuries were iliotibial band syndrome (22.4%), patellar tendonitis (15.1%), and low back pain (11.4%). Although the study provided important data on the occurrence of low back injury in recruits, it failed to investigate an essential question: What are the predictors of low back injury?

Two other prospective studies on injuries in military recruits have been reported. O'Connor and Marlowe (1993) reported a low back pain incidence of 17% in their study of 160 male army basic trainees ⁶. Associations between low back pain and smoking, alcohol use, fitness level, exercise frequency, emotional state, age, education, and race were examined. Smoking was the only statistically significant correlate of low back pain. A major limitation of the study was that all

variables were measured by self-report. In addition, women were excluded from the study. Jones and colleagues (1993) included both males ($\underline{n} = 124$) and females ($\underline{n} = 186$) in their study of army recruits ¹. Objective physiological measures of height, weight, body mass index, and physical performance measures of 1 mile run, number of sit-ups, and number of push-ups were investigated as possible correlates of lost time injuries. Female gender, high BMI, low running performance, and short stature for women were predictors of injury. No measures of functional lifting ability were examined as possible predictors of back injury. The investigators' finding that women recruits are at greater risk for exercise-related injury than men recruits provides support for our proposed study.

Body

Methods

This section consists of five parts: (1) a description of the design, sample and research setting, (2) a discussion of the measurement of functional lifting ability, (3) procedures for data collection, (4) data management and analysis, and (5) strengths and weaknesses of the proposed study. Data will be collected via physical performance measures, questionnaires, and use of existing medical records.

Design, Sample, and Research Setting

This study employs a prospective, non-experimental design to examine associations between back injury and selected physical performance, back knowledge, behavioral, and psycho-social factors. The sample will involve a minimum of 1200 female military recruits, of all races, who are entering basic training. The population to be studied is a normal, non-clinical population. All recruits meeting inclusion criteria will be given the opportunity to participate in the study. Subject recruitment will continue until a sample size of 1200 subjects with complete data has been realized.

Subject exclusion criteria are designed to exclude risk factors and medical conditions causing low back pain which are not related to the conditions of interest and/or which might be a contraindication to functional lifting ability testing. Subjects with the following conditions or symptoms will be excluded from participation in the study:

- 1. Serious underlying spinal pathology (infection, tumor, spinal stenosis, cauda equina syndrome, or other)
- 2. Pregnancy
- 3. Evidence of current urinary tract infection (by history, physical, or laboratory examination)
- 4. Ankylosing spondylitis, rheumatoid arthritis or other rheumatoid or connective tissue disorders

A minimum of 1200 subjects with complete data are required for this study. Originally, a sample of size 700 was estimated based on a power analysis extrapolated from results of a previous study. A recalculation of the power analysis, using a 4% injury estimate for Navy Recruits,

supplied by CDR Rick Shaffer of the Naval Health Research Center, San Diego, resulted in an estimate requiring 1200 subjects. This sample size is estimated to provide a power of .95 at a two-tailed .05 significance level for Rho = .15.

In order to foster efficiency of data collection and minimize interference with recruit training, data routinely collected by the military as part of basic training (e.g.: PFT testing and medical records) will be used. In the original proposal, all initial study-specific testing was proposed to be completed during medical inprocessing time within the first two days after the recruit's arrival on base. This testing includes (a) demographic, back knowledge, and anxiety questionnaires, (b) functional lifting ability, (c) hamstring flexibility, (d) lower body strength, and (e) skinfolds for body composition estimation. It is estimated that not more than 35 minutes of a subject's time would be taken up by this testing, of which approximately 15 minutes is needed for strength and flexibility testing. Since the questionnaires, which require approximately 20 minutes, can be completed at any time, that 20 minute time period does not have to be one contiguous period. Measures of upper body strength, aerobic capacity, height, and weight will be obtained from the routine preliminary medical exam and fitness testing conducted on all recruits.

Data on numbers and types of back injury will be collected from base medical records as well as a Back Injury and Discomfort Self-Report questionnaire filled out prior to graduation. The Back Injury Self-Report questionnaire, requiring approximately 10 minutes to complete, will help to identify back pain and back injuries which interfered with recruit functioning, even though they may not have been medically treated or otherwise not recorded in the subject's medical record.

Copies of all questionnaires and data collection forms appear under Appendix A.

Response Variables

<u>Back injury or discomfort</u>. Occurrence of back injury or discomfort during basic training is defined as an indication on either the recruit's medical record or self-report questionnaire of an episode of lower back pain which occurred after enlistment. This data will be collected prior to basic training graduation, before medical records are pulled for future assignments.

<u>Type of back injury</u>. To provide consistency, Co-Investigator Dr. Michael Mueller will evaluate medical records information. Back injuries will be classified into one of three categories, based on the information obtained from the medical record and/or Back Injury Self-Report Ouestionnaire:

- 1. Nonspecific acute low back pain. Acute or subacute low back pain beginning after enlistment localized to the lumbosacral region, with or without radiation to the thigh, but without radiation below the knee.
- 2. Acute low back pain with sciatica. Acute low back pain beginning after enlistment localized to the lumbosacral region with radiation of pain below the level of the knee on straight leg raising.
- 3. Low back pain due to major trauma. Low back pain due to major trauma resulting in fracture or dislocation, occurring after the date of enlistment.

Predictor Variables

Aerobic capacity is defined as time to complete a two-mile run, as administered for the Army PFT evaluation. The aerobic capacity score will be the subject's VO₂ value in ml/kg/min obtained from a nomogram using time elapsed in minutes for the subject to complete a 2-mile run on a track in basic training ³⁹. Running tests have been found to be a practical and valid means of measuring physical fitness in large groups ⁶⁵. The running test, a dynamic exercise involving large muscle groups, can reveal the individual's maximal aerobic capacity ⁶⁶. High correlations between running velocity and measured VO₂ provide the empirical physiologic basis for this test ^{39,67,68,69,70}.

<u>Upper body strength</u> is comprised of two measures, (a) number of sit-ups completed in two minutes and (b) number of push-ups completed in two minutes, as administered for the Army PFT evaluation. In our pilot study with fire fighters, number of curl-ups in one minute was predictive of trunk performance. Additionally, number of sit-ups in one minute was found to be associated with back pain in our study of fire fighters and police.

<u>Lower body strength</u> is defined as number of squats completed in a one minute time period. Subjects will be asked to stand with arms at sides and instructed to squat, bending at the hips and knees while keeping the trunk vertical. With each squat they will be asked to touch the fingertips of both hands to the floor.

<u>Hamstring flexibility</u> is defined as score on the Acuflex I Sit-and-Reach test. The Acuflex I Sit-and-Reach test, a commonly used flexibility test, is indicative of everyday body movements such as reaching and bending ⁷¹. The subject sits on the floor with legs fully extended, bottom of feet against the Acuflex I and toes pointed up (no shoes), and with one hand on top of the other reaches forward as far as possible to push a sliding device forward with the fingertips. Knees should remain flat against the floor. The flexibility score is the number of inches reached on the best of three attempts.

<u>Functional lifting ability</u>. The floor-to waist lift task is one of 36 work-related functional tasks tested in the Physical Work Performance Evaluation ⁷². This task measures a person's ability to lift progressively heavier weights from the floor to waist height. Each subject will be assessed with an empty weight receptacle to determine that she is using the best possible lifting technique. Weights are then added in five pound increments until a safe maximum is reached. Specific objective observational criteria are used to determine when a maximum level has been reached. The kappa for inter-rater reliability is .78 for this task.

<u>Body mass index</u> is defined as the ratio of weight in kilograms to squared height in meters ⁷³. Height and weight measures will be obtained from subjects' medical records.

<u>Percent body fat</u>. Percent body fat will be estimated using measures of thigh (midline of anterior aspect of thigh, midway between inguinal crease and proximal border of patella), suprailiac (midaxillary line immediately superior to the iliac crest), and tricep (midline of posterior aspect of arm over triceps muscle, midway between lateral projection of acromion process of the ulna) skinfold thickness, as described by ⁷⁴. Three measurements of skinfold thickness will be obtained at each anatomical site, using Lange calipers, and recorded. The average of the three values will be used to estimate percent body fat.

<u>Back knowledge</u> is defined as the number of correct subject responses to 13 items on spine anatomy and physiology, proper lifting, and ergonomics on the Back Knowledge Questionnaire. Six items were modifications of White's back evaluation questionnaire ⁷⁵. Remaining items were investigator-developed and adapted from those used in our previous research. Content validity was assessed by a panel of three experts in the fields of ergonomics, occupational health nursing, and physical therapy. Initially our test-retest reliability was .67. Subsequent to receiving reviewers' comments, we conducted a second test-retest reliability assessment in January 1992. Test-retest reliability with a two week interval between tests was .79 on 33 maintenance workers.

<u>Smoking</u> is measured by self-report regarding cigarette and other tobacco use on the Demographic Questionnaire. These items are adapted from the "Good Health Program" Health Risk Appraisal Questionnaire.

Anxiety. Anxiety will be measured using the State-Trait Anxiety Inventory (STAI, Form Y) which measures both state and trait anxiety ⁷⁶. The STAI is a 40 item, self-administered test that requires about 10 minutes to complete and is written below the sixth-grade reading level. Two scores will be obtained on the STAI. One score will reflect the person's current level of state anxiety and can range from 20 to 80 with higher scores reflecting more anxiety. The other score indicates the person's general level of trait anxiety and also can range from 20 to 80 with higher scores indicative of more anxiety. The internal consistency of the Trait-anxiety scale, as indexed by coefficient alpha, ranges from .89 to .91 across male and female samples of working adults, military recruits, and college and high school students. For the State-anxiety scale, this range is from .86 to .95.

<u>Life satisfaction</u>. Self-report regarding life satisfaction on the Demographic Questionnaire. This item is adapted from the "Good Health Program" Health Risk Appraisal Questionnaire.

<u>Parental status</u>. Self-report regarding whether the subject is primary caregiver for a child of six years or younger on the Demographic Questionnaire.

Education. Self-report of highest grade level completed on the Demographic Questionnaire.

Age. Calculated from self-reported date of birth, representing age at time of entry into the study.

Race. Self-report response to two items on the Demographic Questionnaire. These items are adapted from the "Good Health Program" Health Risk Appraisal Questionnaire.

Previous back injury. Demographic Questionnaire self-report of back injury prior to enlistment.

Data Collection Procedures

Data collectors will include physical therapists and graduate research assistants local to the military base. Physical therapist training for measuring functional lifting ability will be accomplished on-site by Deborah Lechner, MS, PT (physical therapist). Research assistants will be trained in administration of the hamstring flexibility and lower body strength measures, as well as use of the data collection forms. All physiologic measurements will be done under similar circumstances, with at least 15 minutes rest period between functional lifting ability and lower body strength testing. A pilot study of 10 subjects is planned to verify subject recruitment, scheduling, testing, data retrieval, and follow-up procedures. To minimize attrition, we will work

closely with training personnel and subjects to schedule testing times that do not interfere with processing activities.

Results: No results are available at this time.

Recommendations

Site Acquisition

In the Year 1 progress report filed in October 1997, site acquisition was noted as a primary focus for grant efforts. With the assistance of Rear Admiral Joan Engel in October 1997, we secured the assistance of CDR Rick Shaffer of the Naval Health Research Center, San Diego for gaining permission to access recruits at Recruit Training Command Great Lakes. We have received permission to enroll subjects at RTC (See Appendix B), recruited Mr. Barry Hoag, Chief Naval Education & Training, as Administrative Principal Investigator, and have been provided with space to conduct testing.

As this infrastructure was being put in place, a Program Manager local to the RTC area was hired, a cadre of physical therapists has been trained in the Functional Lift Test method, and Research Assistants have been identified to assist in data collection. Our research protocol is scheduled for review by the Clinical Information Department's IRB, National Naval Hospital, Bethesda on 12 November, and we expect to begin collecting data as soon as that approval is obtained.

Protocol Revision

Subject Testing

We eliminated use of the B200 testing as recommended in our Year 1 report in order to simplify testing and reduce recruit testing time so as to minimize training schedule impact. In addition, the subject numbers were increased, based on power analysis results, to accommodate the lower injury rate experienced by Navy recruits in basic training compared to their Army counterparts. We believe that the revised sample size (1200) is achievable, since RTC processes over 50,000 recruits per year.

In response to concerns expressed by Naval Recruit Training Command Great Lakes (RTC), we are exploring alternative subject enrollment and testing schedules that would not interfere with training schedules. Specifically, we are trying to identify a schedule which would not split up a training division for testing during their first week on base. This may be achievable through testing during medical inprocessing time, and we are working with CDR Hackman, director of the 1523 Clinic to see if such an arrangement is feasible.

As an alternative, we would be able to test recruits during their 5th week of training, when they are split up and assigned to various work details around the base. Testing during their 5th week would not, according to RTC training staff, interfere with training regimens.

Recruit testing only during the 5th week of training would be problematic for the study, however, in that, with the most vigorous physical training occurring during the first weeks, those most prone to injury may be lost to study.

A potential workaround for 5th week testing would be to randomly test as many recruits as we could during the first week of training, with the remainder of the sample tested at Week 5. This would provide the opportunity, depending on distribution of sample sizes at Weeks 1 & 5, to determine (a) if there were differences in performance between Weeks 1 & 5 and (b) if characteristics of those discharged from training by week 5 were different from the Week 1 sample. While not ideal, we believe that this compromise would provide sufficiently useful information to justify the study.

Data Collection

We revised our data collection forms to make them easier for subjects and staff to use and to provide the possibility of producing forms readable by a new OCR Form Scanning system (Teleform) that was obtained by the School of Nursing. In addition, we determined that all information required for the medical records evaluation is available through the 1523 Clinic's computerized medical records system, and we can obtain that data in machine-readable form, further simplifying data collection procedures and reducing the probability for transcription errors. I have retained the previous medical records information form in this report to show the types of information we are interested in, even though the form itself will not be used for data collection.

Summary

Site acquisition has been a major emphasis to date for the grant. We have obtained approval and been assigned space to conduct the study at RTC Great Lakes.

Protocols have been revised to streamline testing, limit impact on recruit training, and accommodate testing 1200 subjects in a shorter time frame.

Plans for the no-cost extension year (Year 03) are to complete data collection and preliminary data analysis and reporting. A revised **Statement of Work** has been included with this report.

Conclusions: No conclusions are available at this time.

References

- 1. Jones BH, Bovee MW, Harris JA, Cowan DN. Intrinsic risk factors for exercise-related injuries among male and female army trainees. *The American Journal of Sports Medicine*. 1993;21(5):705-710.
- 2. Friedl K, Nuovo J, Patience T, Dettori J. Factors associated with stress fracture in young Army women: indications for further research. *Mil Med.* 1992;157(7):334-338.
- 3. Jones B, Cowan D, Tomlinson J, Robinson J, Polly D, Frykman P. Epidemiology of injuries associated with physical training among young men in the Army. *Med Sci Sports Exerc*. 1993;25(2):197-203.
- 4. Deen HJ, Yamodis N. Lumbar disk disease in active duty military personnel. *Mil Med.* 1989;154(10):502-504.
- 5. Linenger JM, West LA. Epidemiology of soft-tissue/musculoskeletal injury among U.S. Marine recruits undergoing basic training. *Military Medicine*. 1992;157(9):491-493.
- 6. O'Connor FG, Marlowe SS. Low back pain in military basic trainees. A pilot study. *Spine*. 1993;18(10):1351-1354.
- 7. Anderson ST, Charlesworth RW. Rheumatologic disease among Air Force recruits: a multimillion-dollar epidemic. *Seminars in Arthritis & Rheumatism*. 1993;22(4):275-279.
- 8. Frymoyer J., Mooney V. Current concepts review: Occupational orthopedics. *Journal of Bone and Joint Surgery*. 1986;68-A:486-473.
- 9. Andersson G, Pope M, Frymoyer J, et al: Epidemiology and cost. In Pope M, Andersson G, Frymoyer J, et al (eds.): Occupational Low Back Pain: Assessment, Treatment, and Prevention. St. Louis, Mosby-Year Book, 1991, p. 106.
- 10. Rogers B. Developing research priorities in occupational health nursing. *American Association of Occupational Health Nurses' Journal*. 1989;37(12):493-500.
- 11. DHHS. Healthy people 2000: National health promotion and disease prevention objectives. US Public Health Service. 1991.
- 12. Skovron ML. Epidemiology of low back pain. *Baillieres Clinical Rheumatology*. 1992;6(3):559-573.
- 13. Frymoyer JW, Cats-Baril W. Predictors of low back pain disability. *Clin Orthop*. 1987;221(Aug):89-98.
- 14. Borenstein D. Epidemiology, etiology, diagnostic evaluation, and treatment of low back pain. *Current Opinion In Rheumatology*. 1992;4(2):226-232.
- 15. Anderson R. The back pain of bus drivers. Prevalence in an urban area of california. *Spine*. 1992;17(12):1481-1488.
- 16. Battie M, Bigos S, Fisher L, Spengler D, Hansson T, Nachemson A, & Wortley M. The role of spinal flexibility in back pain complaints within industry: A prospective study. *Spine*, 1990;15 (8):768-773.
- 17. Bigos SJ, Battie MC, Fisher LD. Methodology for evaluating predictive factors for the report of back injury. *Spine*. 1991;16(6):669-670.
- 18. Frymoyer J., Gordon S. (1989). Research perspective in low back pain. *Spine*. 1989;14 (12):1384-1390.
- 19. Knapik J, Ang P, Reynolds K, Jones B. Physical fitness, age, and injury incidence in infantry soldiers. *J Occup Med.* 1993;35(6):598-603.
- 20. Pietri F, Leclerc A, Boitel L, Chastang JF, Morcet JF, Blondet M. Low-back pain in commercial travelers. *Scand J Work Environ Health*. 1992;18(1):52-58.

- 21. Suadicani P, Hansen K, Fenger AM, Gyntelberg F. Low back pain in steelplant workers. *Occup Med.* 1994;44(4):217-221.
- 22. Graveling RA. The prevention of back pain from manual handling. *Ann Occup Hyg.* 1991;35(4):427-432.
- 23. Bigos SJ, Battie MC, Fisher LD, Hansson TH, Spengler DM, Nachemson AL. A prospective evaluation of preemployment screening methods for acute industrial back pain. *Spine*. 1992;17(8):922-926.
- 24. Himmelstein JS, Andersson GBJ. Low back pain: risk evaluation and preplacement screening. Occup Med: State of Art Rev 1988;3(2):255.
- 25. Tsang IK. Perspective on low back pain. Curr Opin Rheumatol. 1993;5(2):219-223.
- 26. Snook, S. (1987a). Approaches to the control of back pain in industry: Job design, job placement and education/training. *Spine: State of the art reviews*. 1987a;2(1):45-59.
- 27. Chaffin DB. Human strength capability and low back pain. J Occup Med. 1974;16:248.
- 28. Keyserling W, Herrin G, Chaffin D. Isometric strength testing as a means of controlling medical incidence on strenuous jobs. *J Occup Med* 1980;22:332.
- 29. Lamb DR. Physiology of exercise. New York: Macmillan Publishing Co. 1984.
- 30. Arnheim DD. *Modern principles of athletic training*. St. Louis, MO: C.V. Mosby Co. 1985.
- 31. Paris SV. The role of the physical therapist in pain control programmes. *Clinics Anesthesiology*. 1985;3,:250.
- 32. Sealey DE. Practical consultation in flexibility exercises for knee and lower extremities. In L. Hunter & F. Funk (Eds.), *Rehabilitation of the injured knee*. St. Louis, MO: C. V. Mosby Co. 1984.
- 33. Tall RL, DeVault W. Spinal injury in sport: epidemiologic considerations. *Clin Sports Med.* 1993;12(3):441-448.
- 34. Gracovetsky S, Farfan H. The optimum spine. Spine. 1986;5:543-571.
- 35. Ekstrand J, Gillquist J, Liljedahl S. Prevention of soccer injuries. *American Journal of Sports Medicine*. 1983;10:75-78.
- 36. Wiktorsson-Moller M, Oberg B, Edstrand J, Gillquist J. Effects of warming up, massage and stretching on range of motion and muscle strength in the lower extremity. *American Journal of Sports Medicine*. 1983;11:249-252.
- 37. Chandler T, Kebler W, Uhl T, Wooten B, Kiser A, Stone E. Flexibility comparisons of junior elite tennis players to other athletes. *American Journal of Sports Medicine*. 1990;18:134-136.
- 38. Fathallah FA, Marras WS, Wright PL. Diurnal variation in trunk kinematics during a typical work shift. *J Spinal Disord*. 1995;8(1):20-25.
- 39. Pollock M, Wilmore J. *Exercise in health and disease*. Philadelphia: W. B. Saunders Co. 1990.
- 40. Jones D, Rutherford OL, Parker D. Physiological changes in skeletal muscle as a result of strength training. *Quarterly Journal of Experimental Physiology*. 1989;74:233-256.
- 41. Jones D, Rutherford O. Human muscle strength training: The effects of three different regimes and the nature of the resultant changes. *Journal of Physiology*. 1987;391:1-11.
- 42. Jackson C, Brown M. Analysis of current approaches and a practical guide to prescription of exercise. *Clinical Orthopedics and Related Research*. 1983;179(October):46-54.

- 43. Kahanovitz N, Nordin M, Verderame R, Yabut S, Parnianpour M, Viola K, Mulvihill M. Normal trunk muscle strength and endurance in women and the effect of exercises and electrical stimulation. Part 2: Comparative analysis of electrical stimulation and exercises to increase trunk muscle strength and endurance. *Spine*. 1987;12:112-118.
- 44. Pollock M, Leggett S, Graves J, Jones A, Fulton M, Cirulli J. Effect of resistance training on lumbar extension strength. *American Journal of Sports Medicine*. 1989;17:624-629.
- 45. Hall H. The back school. In C. Tollison & M. Kriegel (Ed.), *Interdisciplinary* rehabilitation of low back pain. Baltimore: Williams & Wilkins. 1989.
- 46. Kendall P, Jenkins J. Exercises for backache: A double-blind controlled trial. *Physiotherapy*. 1968;54:154-157.
- 47. Snyder-Mackler, L. (1989) Rehabilitation of the athlete with low back dysfunction. *Clinics in sports Medicine*. 1989;8:717-729.
- 48. Cady LD, Bischoff DP, O'Connell ER, et al. Strength and fitness and subsequent back injuries in firefighters. *Journal of Occupational Medicine*. 1979;21:269-272.
- 49. Cady L, Thomas P, Karwasky R. Program for increasing health and physical fitness of fire fighters. *Journal of Occupational Medicine*. 1985;27:110-114.
- 50. Tollison CD, Kriegel ML. Physical exercise in the treatment of low back pain, part 1: A review. *Orthopedic Review*. 1988;17:724-729.
- 51. Mostardi RA, Noe DA, Kovacik MW, Porterfield JA. Isokinetic lifting strength and occupational injury. A prospective study. *Spine*. 1992;17(2):189-193.
- 52. Deyo RA, Bass, JE. Lifestyle and low back pain. The influence of smoking and obesity. *Spine*. 1989;14(5):501-506.
- 53. Manninen P, Riihimak H, Heliovaara M. Incidence and risk factors of low-back pain in middle-aged farmers. *Occup Med.* 1995;45(3):141-146.
- 54. Toroptsova NV, Benevolenskaya LI, Karyakin AN, Sergeev IL, Erdesz S. Cross-sectional study of low back pain among workers at an industrial enterprise in russia. *Spine*. 1995;20(3):328-332.
- 55. Wright D, Barrow S, Fisher AD, Horsley SD, Jayson MI. Influence of physical, psychological, and behavioral factors on consultations for back pain. *Br J Rheumatol*. 1995;34(2):156-161.
- 56. Boshuizen HC, Verbeek JH, Broersen JP, Weel AN. Do smokers get more back pain? *Spine*. 1993;18(1):35-40.
- 57. Garrett B, Singiser D, Banks SM. Back injuries among nursing personnel: the relationship of personal characteristics, risk factors, and nursing practices. *AAOHN J*. 1992;40(11):510-516.
- 58. Garzillo MJ, Garzillo TA. Does obesity cause low back pain? *J Manipulative Physiol Ther*. 1994;17(9):601-604.
- 59. Croft PR, Rigby AS. Socioeconomic influences on back problems in the community in britain. *J Epidemiol Community Health*. 1994;48(2):166-170.
- 60. Finkelstein MM. Back pain and parenthood. Occup Environ Med. 1995;52(1):51-53.
- Wohl AR, Morgenstern H, Kraus JF. Occupational injury in female aerospace workers. *Epidemiology*. 1995;6(2):110-114.
- 62. Riihimaki H, Viikari-Juntura E, Moneta G, Kuha J, Videman T, Tola S. Incidence of sciatic pain among men in machine operating, dynamic physical work, and sedentary work. A three-year follow-up. *Spine*. 1994;19(2):138-142.

- 63. Hellsing AL. Passive lumbar mobility. A prospective study of back pain in young men during their military service. *Upsala J Med Sci.* 1988;93(3):255-265.
- 64. Hellsing AL. Leg length inequality. A prospective study of young men during their military service. *Upsala J Med Sci.* 1988;93(3):245-253.
- 65. American College of Sports Medicine. *Guidelines for Exercise Testing and Prescription*. Philadelphia: Lea & Febiger, 1986.
- 66. Leff A. Cardiopulmonary exercise testing. Orlando: Grune & Stratton. 1986.
- 67. Cooper K. A means of assessing maximal oxygen intake. *Journal of the American Medical Association*. 1968;203(3):135-138.
- 68. Cooper K. *The aerobic way*. New York: M. Evans and Company. 1977.
- 69. National Center for Health Statistics. *Assessing physical fitness and physical activity in population-based surveys*. Dhhs Pub. No (PHS) 89-1253. Washington: U. S. Government Printing Office. 1989.
- 70. Skinner J. Exercise testing and exercise prescription for special cases. Philadelphia: Lea & Febiger.1987.
- 71. Hoeger W, Hopkins D, Johnson L. Assessment of muscular flexibility. Addison, Illinois: Novel Products. 1988.
- 72. Lechner D. Work technology review: Smart-LiftSM. Work: A Journal of Prevention, Assessment & Rehabilitation. 1994;4:223-225.
- 73. Keys A, Fidanza F, Karvonen M, Noboru K, Taylor H. Indices of relative weight and obesity. *Journal of Chronic Diseases*. 1972;25:329-343.
- 74. Jackson AS, Pollock ML, Ward ML. Generalized equations for predicting body density of women. *Med Sci Sports Exercise*. 1980;12, 175-.
- 75. White A. *Back school and other conservative approaches to low back pain*. St. Louis: C. V. Mosby Company. 1983.
- 76. Spielberger CD, Gorusch RL, Lushene R, Vagg PR, Jacobs GA. *Manual for the state-trait anxiety inventory STAI (form Y)*. Palo Alto, CA: Mind Garden. 1983

Appendices

Appendix A

Data Collection Instruments

Forms Completed by Subjects At Entry

Predictors of Back Injury & Discomfort Among Women Military Recruits

Demographic Questionnaire

			Today's Date:						
Name:			Birth Date:	Unit	ID:				
		g questions tell us something a arranswer to the question.	bout yourself, and your med	lical history. Please o	circle the letter that best				
1.	What is the highest grade you completed in school?								
	a)	Grade school or less							
	b)	Some High School							
	c)	High School Graduate							
	d)	Some College							
	e)	College Graduate							
	f)	Post Graduate or Profession	al Degree						
2.	Are y	you currently:							
	a)	Never Married							
	b)	Married							
	c)	Divorced							
	d)	Separated							
	e)	Widowed							
3.	What is your race?								
	a)	Aleutian, Alaska Native, Es	kimo, or American Indian						
	b)	Asian							
	c)	Black							
	d)	Pacific Islander							
	e)	White							
	f)	Other							
4.	Are you of Hispanic origin?								
	a)	Yes							
	b)	No							
5.	Do y	ou currently have a child or chi	ldren under the age of six fo	or which you are the p	primary care giver?				
	a)	No							
	b)	Yes, 1 child							
	c)	Yes, 2 children or more							
6.	Are y	you currently pregnant?							
	a)	Yes							
	b)	No							
	c)	Don't Know							

7.	Do you now have a bladder infection or any symptoms of a bladder infection (for example, burning on urination, frequent urination,)?						
	a)	Yes					
	b)	No					
8.	-	ou have now or have you had a serious problem with your spine (for example: infection, tumor, deformity)?					
	a)	Yes					
	b)	No					
9.	Do y	ou have now or have you had ankylosing spondylitis, rheumatoid arthritis or other disease of the joints?					
	a)	Yes					
	b)	No					
10.	Do y	ou currently have back discomfort?					
	a)	Yes					
	b)	No (Go to question 12)					
11.	_	u are currently having back discomfort, is it located higher than mid-way between your waist and shoulders?					
	a)	Yes					
	b)	No					
12.	Have	you had lower back discomfort in the past?					
	a)	Yes					
	b)	No (Go to Question # 21)					
13.	Have	you ever had back surgery?					
	a)	Yes					
	b)	No					
14.	Have	you ever received medical treatment for back discomfort?					
	a)	Yes					
	b)	No					
15.	Have	you ever missed work or school because of back discomfort?					
	a)	Yes					
	b)	No					
16.	Do y	ou still have lower back discomfort occasionally?					
	a)	Yes					
	b)	No (Go to Question # 21)					
17.	If yo	u still have back discomfort occasionally, how long ago did the problems first start?					
	a)	Years: Months:					
18.	If yo	u still have back discomfort occasionally, did the discomfort start with an injury at work?					
	a)	Yes					
	b)	No					

19. •	If you still have back discomfort occasionally, have you received any medical treatment for it in the past year?						
	a)	Yes					
	b)	No					
20	If yo	u still have back discomfort occasionally, do you do any exercises now to strengthen your back?					
	a)	Yes					
	b)	No					
21.	How	would you describe your cigarette smoking habits?					
	a)	Never Smoked					
	b)	Used to Smoke					
	c)	Still Smoke					
22.	If yo	u still smoke: how many cigarettes a day do you smoke? (Fill in number):					
23.	-	u used to smoke: How many years has it been since you smoked cigarettes fairly regularly? (Fill in ber):					
24.	vigo: and v	to enlisting, in an average week, how many times did you participate in a sport or activity that required rous physical activity? Lively physical activity is exercise which lasted at least 20 minutes without stopping, was hard enough to make you breathe heavier and your heart beat faster.					
	a)	Less than 1 time per week					
	b)	1 or 2 times per week					
	c)	At least 3 times per week					
25.	Thin	king back on previous jobs you have had, in general, how satisfied with your jobs were you?					
	a)	Mostly satisfied					
	b)	Partly satisfied					
	c)	Not satisfied					

State Anxiety Questionnaire

Trait Anxiety Questionnaire

Predictors of Back Injury & Discomfort Among Women Military Recruits

Back Knowledge Questionnaire

			Today's Date:						
Name:		2,000	Birth Date:	Unit:	ID:				
The fol	lowing q	uestions are about back	k health care. On each quest	tion, please circle who	at you believe is the best answer.				
1.	Which f	Which factor is the most important for prevention of back injury:							
	a)	having machines to do	your work for you						
	b)	exercise, correct lifting	g techniques, proper nutrition	n, and good posture					
	c)	having an excellent do	ctor and proper medication						
2.	The bon	y spine is supported ar	nd kept erect by:						
		blood vessels	•						
	b)	muscles and ligaments	;						
		nerves							
3.	There as	There are nerves coming out above or below each vertebra in the spine. These nerves can lead to pain if:							
	a)	they are irritated or inf	flamed						
	b)	they have pressure on	them caused by bulging disk	as .					
	c)	both of the above							
4.	Which o	Which of the following is not helpful in reducing back injury:							
			or large, get assistance who						
	b)	use a step or platform	to keep from lifting above sl	noulder level					
	c)	when a load can be pu	shed or pulled, pull the load	with a rounded back					
5.	Which o	Which one of the following is most likely to cause back injury:							
	a)	sitting							
		lifting with bent knees							
	c)	twisting the back while	e lifting						
6.	During 1	ifting a moderately he	avy object, the knees should	be:					
	,	one knee bent, the other	er straight						
	,	both bent							
	c)	both straight							
7.	When li	fting, the optimal posit	tion for the low back is:						
	,	arched							
	,	flattened out							
	c)	neutral (somewhere be	etween fully arched & fully f	lattened out that feels	s comfortable)				
8.	When p	ulling a heavy object, v	which muscles should do the	most work:					
	,	arm muscles							
		leg muscles							
	c)	back muscles							

- 9. When pulling a heavy object, a person should:
 - a) arch the back to support the object
 - b) angle the body around the object
 - c) try to maintain the back in a neutral position
- 10. When lifting you should:
 - a) hold the load as close to the body as possible
 - b) not twist the back
 - c) both of the above
- 11. When bending over to pick up a heavy object:
 - a) squat down, keeping the back in a neutral position
 - b) squat down, arching the back
 - c) lock your knees
- 12. To keep the load close and maintain good balance during lifting:
 - a) keep your feet close together and reach out over your knees to get the load
 - b) keep your feet apart and get the load in between your knees
 - c) lean backwards and hold your head back
- 13. When carrying a load upstairs you should:
 - a) carry the load with a bent back to relieve muscles
 - b) face forward with your head in a neutral position, glancing down with eyes to watch steps from time to time if needed
 - c) look down at your feet and turn to look behind you every few steps
- 14. When pulling an unconscious or injured person away from danger you should:
 - a) face the victim and pull as you walk backward, keeping your back as straight as possible
 - b) twist your back to turn in the direction you are going while pulling the victim
 - c) both of the above
- 15. When lifting, your stomach muscles should be:
 - a) fully relaxed
 - b) fully tightened, while holding your breath
 - c) somewhat tightened, while breathing normally

Thank you for your willingness to participate in this study!

Forms Completed by Subjects At Exit

Predictors of Back Injury & Discomfort Among Women Military Recruits

Back Injury & Discomfort Self-Report Questionnaire

	Today's Date:	
Name:	Birth Date: Unit: ID#	
Please	answer the following questions regarding any back problem you may have had during basic training:	
1.	Did you experience any back injury or discomfort during basic training? a) Yes (Go to Question # 2) b) No (STOP: Thank you for participating in this study!)	
2.	Did the back injury or discomfort make it harder to perform any basic training activities? a) Yes (Go to Question # 3) b) No (STOP: Thank you for participating in this study!)	
3.	How many times did you experience back injury or discomfort during basic training that made it harder to perform the basic training activities? a) Times.	
For que	estions 4 - 10, please think about the back injury or discomfort that caused you the MOST PROBLEMS duri Basic Training:	ng
4.	What caused you to experience the back discomfort (Example: Lifting field pack off ground.)?	
5.	Where was the discomfort located? a) Below the middle of your back b) Above the middle of your back	
6.	How severe was the discomfort? a) Mildb) Moderate c) Severe	
7.	How did the discomfort feel? a) Dull b) Sharp	
8.	Did you experience pain or discomfort in a) Back Only b) Back and running down to knee c) Back and running down to foot	
9.	Did you report the back injury or discomfort to the medical clinic? a) Yes b) No	
10.	Were you placed on limited or restricted duty due to the back discomfort? a) Yes (Go to Question 11.) b) No (STOP: Thank you for participating in this study!)	
11.	How long were you placed on limited or restricted duty due to the back discomfort? Days	

Thank you for participating in this study!

Forms Completed by Project Staff At Entry

Predictors of Back Injury & Discomfort Among Women Military Recruits

Physical Therapist Evaluation of Lifting Technique With Empty Box

	Today's Date: _	MICO NO.	
Name:	Birth Date:	Unit:	ID:
Physical Therapist:	A		
1. Vertical alignment	of trunk		
1 2	3	4	5
Poor Vertical Alignment	Moderate Vertice Alignment	al	Perfect Vertical Alignment
2. Use of squat techn	ique		
1 2	3	4	5
Poor Use of Squat (knees almost straight)	Squat (knees	Moderate Use of Squat (knees somewhat flexed)	
3. Base of Support			
1 2	3	4 	5
Narrow Base of Support	Base of Support Could be Wider		Appropriate Base of Support
4. Distance of Load f	rom Body		
1 2	3	4	5
Load held far away from body throughout lift	Load fairly close body but not touching or inconsistent depending on pho of lift		Load held up next to body throughout lift.
Total Score:			
Needs further instruction:	Yes No		

Functional Lift Task Form



SECTION I DYNAMIC STRENGTH

TASK 1. LIFT - FLOOR TO WAIST

JOB DEMAND:____LBS

AER	WEIGHT	THUE	HG	PAIS	LOCATON	EVED OF MAX	E-A-BOORE
2							
3.							
4							
5.							
.6.							
7							
8							
9.0							
11.							

Limiting Factor(s): (What made this task hard/difficult for you?)	

SCORING CRITERIA

Position for Observation: Sagittal Plane (either side)

Self Assessment Score:

Appropriate 0E Over-extending SL Self-limiting

Sub-Max:(SM) No Signs of Near-Max

Near-Max Effort:(NM)

- 1. Face Red/Perspiration
- 2. Accessory Muscles
- 3. Post Trunk Lean
- 4. Elbow Extension
- 5. Hands Slip/Difficulty Holding Box
- 6. Decreased Box Control
- 7. Shaking/Quivering
- 8. Raises on Tip Toe

- 9. Increased Time to Complete Repetitions
- 10. Vertical Trunk Alignment Decreases
- 11. Props Box on Thigh
- 12. Irregular Steps13. Increased Thoracic Kyphosis with Protraction of the Shoulder Girdle
- 14. Other _

Maximal Effort: (M)

- 1. Completes Lift but Intensity of Near-Max Signs Increases Unsafe
- 2. Completes Lift but New Near-Max Signs Appear Unsafe
- 3. Unable to Complete Lift:
 - a. Unable to Lift from Floor
 - b. Unable to Lift to Waist
 - c. Unable to Rise from Squat

Predictors of Back Injury Among Women Military Recruits

Physical Performance Information Form

		Today's Date:	<u> </u>	
Name:		Birth Date:	Unit:	ID:
# Squats in 60 Seconds:	-			
Sit-And-Reach (Inches from	n 0): Trial #1:	Trial #2:		
SKINFOLD Measures (near	rest mm):			
SITE	# 1		# 2	# 3
Tricep		·		
Suprailium				
Thigh				
PFT Testing Date (MMDD)	YY):			
Two-Mile Run Time (MM:	SS):		*	
# Push-Ups In Two Minutes				
# Sit-Ups In Two Minutes:		-		
Percent Body Fat:				

Forms Completed by Project Staff At Exit

Predictors of Back Injury Among Women Military Recruits

Medical Record Back Pain Report Form

	Today's Date: _			
Name:	Birth Date:	Unit:	ID:	_
Enlistment Height (Inches):		Enlistment Weight (Pounds):		
NOTE: If no back pain or injuries noted	on medical record	l, write "NONE".		

Injury Date	Injury Type*	ICD9CM Code	Duty Restriction Type & Length	Cause

- 1. Nonspecific acute low back pain. Acute or subacute low back pain localized to the lumbosacral region, with or without radiation to the thigh, but without radiation below the knee.
- 2. Acute low back pain with sciatica. Acute low back pain localized to the lumbosacral region with radiation of pain below the level of the knee on straight leg raising.
- 3. Low back pain due to major trauma. Low back pain due to major trauma resulting in fracture or dislocation.

Appendix B

Permission To Conduct Research at RTC, Great Lakes

From: BARRY HOAG [barry_hoag_at_gtlcn13@pens3646.cnet.navy.mil]

Sent: Tuesday, April 21, 1998 11:05 AM

To: weaverm@uab.edu

Subject: PERMISSION TO CONDUCT RESEARCH AT RTC, GREAT LAKES

Dr. Weaver,

You have Recruit Training Commands permission to use recruits to conduct your back research. The only requirements will be to gain a release from each recruit and to coordinate all research conducted with me. If you have any questions you can reach me at (847)688-2679.

BARRY HOAG
BY DIRECTION

Appendix C

One Year No-Cost Extension



Office of Grants and Contracts Administration

October 6, 1998

MEMORAND UM

To: Dr. Michael Weaver

From: Jyothi Yarlagadda Jyou

Grants and Contracts Officer

Re: Modification No. P80001

U.S. Army Contract No. DAMD17-96-1-6268

Enclosed for your records is a copy of the fully executed agreement referenced above and a copy of the letter indicating approval of the consulting travel. If you have any questions regarding your account please call Tina Hagans in Grants and Contracts Accounting at 4-9330.

Enclosure

cc: Tina Hagans

GRENT AGREEMENT

FULLY EXECUTED

GRANT NO: DAMD17-96-1-6268 Modification No.: P80001

EFFECTIVE DATE See Grant Officer Signature Date Below GRANT AMOUNT

Page 1 of 1 Patricia A. Shoop (301) 619-2175

EFT:T

PROJECT TITLE: "Predictors of Back Injury Among Women Military Recruits"

CFDA 12.420

. .

PERFORMANCE PERIOD: 1 October 1996 - 1 November

PRINCIPAL INVESTIGATOR:

1999 (Research Ends 30 September 1999)

Dr. Michael Weaver

AWARDED AND ADMINISTERED BY:

U.S. Army Medical Research Acquisition Activity ATTN: MCMR-AAA-A

820 Chandler St.

701 20th Street South

AWARDED TO:

Fort Detrick Maryland 21702-5014

1170 Administration Building

Birmingham, AL 35294-0111

PAYMENTS WILL BE MADE BY:

Army Vendor Pay 1-888-478-5636

DFAS-SA/FPA

\$260,942.00

500 McCullough Ave

San Antonio, TX 78215-2100

REMIT PAYMENT TO:

The University of Alabama at Birmingham ATTN: Grants and Contracts Accounting Administration Building 990

Birmingham, AL 35294-0109

ACCOUNTING AND APPROPRIATION DATA: N/A

The University of Alabama at Birmingham

SCOPE OF WORK:

Pursuant to mutual agreement, the following changes are made in the provisions of this grant:

A. The period of performance is extended without funds in order to complete the research project. Therefore, the period of performance is changed:

FROM: 1 October 1996 - 1 November 1998 (Research Ends 1 October 1998)

TO: 1 October 1996 - 1 November 1999 (Research Ends 30 September 1999)

- B The Statement of Work which was incorporated into the Grant is hereby replaced by the revised Statement of Work dated 2 September 1998, which is incorporated herein by reference.
- C. All reporting requirements shall continue throughout the extended period of

All other terms and conditions of the Grant remain unchanged.

RECIPIENT	UNITED STATES OF AMERICA Alaum Phinbur		
ACCEPTED BY: No Signature Required. See Grantee's Letters Dated September 2 & 10, 1998.			
SIGNATURE	SIGNATURE		
NAME AND TITLE DATE	NAME AND TITLE JEAN M. SHINBUR	DATE	
USAMRAA FORM 25-R-E, MAR 97 (Previous editions are obsolete)	GRANT OFFICER	30 Dep 98	

•

Appendix D

Revised Statement Of Work

Statement of Work

Technical Objective:

Task 1: Month 1: Print & collate data collection forms, train data collectors.

Task 2: Month1: Pilot study to test procedures and reliability of measures.

Task 3: Months 2-6: Collect data on 1200 female recruits undergoing basic training.

Task 4: Months 4-8: Collect medical data and post-training back injury questionnaire on 1200 female recruits.

Task 5: Months 9-12: Analyze Data & begin manuscript preparation